

3.5.3 Ankle/Arm Blood Pressure

I. BACKGROUND AND RATIONALE

The presence of peripheral vascular disease will be assessed with the ankle/arm blood pressure index (ABI). A low ABI is highly correlated with lower extremity arterial disease and has been shown to predict all-cause and cardiovascular mortality in several studies. A normal ABI is 1.0 to 1.5, with progressively lower values corresponding to worsening arterial disease. This method may underestimate, however, the occurrence of the disease in patients with long-standing diabetes, due to medial arterial calcification and incompressibility of blood vessels.

II. EQUIPMENT AND SUPPLIES

- Nicolet Doppler apparatus (EN50 LE 100, Nicolet vascular, Golden, CO) with an earpiece.
- gV batteries.
- Two full tubes of ultrasound transmission gel. (Gel can be purchased in bulk and tubes refilled.)
- A mercury sphygmomanometer with a male quick release coupler. The mercury column manometer should be mounted at “eye level.”
- Blood pressure cuffs: adult, large adult, and thigh
- Arm cuffs: Two 16 cm wide arm blood pressure cuffs (large arm), two 12 cm wide arm blood pressure cuffs (regular arm or adult), two 10 cm wide arm blood pressure cuffs (pediatric or child), and two thigh blood pressure cuffs.
- Tissue or wash cloth to remove the ultrasound contact gel.
- Black ball point pen and a marker.
- Ankle-Arm Blood Pressure Form.

III. DEFINITIONS

1. Peripheral vascular disease, peripheral atherosclerosis, and peripheral arterial obstructive disease are synonyms. Peripheral vascular disease does not refer to venous disease, small-artery obstructive disease, vasospastic disease, cold sensitivity, or capillary disease.
2. The ABI is a ratio of ankle to arm pressure and is computed separately for each leg. The numerator for the right leg is the higher of the two systolic ankle pressures (posterior tibial or dorsalis pedis) in the right leg. The numerator for the left leg is the higher of the two systolic ankle pressures in the left leg. The denominator for both legs is the average of the right and left brachial systolic blood pressures. If the two arm pressures differ by 10 mm Hg or more, take the higher arm pressure instead as the denominator.

3. An ABI of 0.90 or less is considered peripheral arterial disease, although peripheral arterial disease could exist if the ABI is 0.95 or less.
4. Moderate to severe lower extremity arterial obstructive disease is considered to be present if the ABI is less than 0.80.
5. Medial calcification could exist in an artery, if the ankle systolic blood pressure exceeds 290 mm Hg in any participant or 240 mm Hg in a participant with brachial systolic pressure less than 160 mm Hg; or if the ABI index is >1.5 .

IV. METHODS

1. Preparation

- 1.1 Thoroughly explain the procedure to the participant and allow him/her to ask questions.
- 1.2 Conduct the examination in a quiet, warm, and comfortable room. If the room is cool, a blanket may be used to cover the participant (including arms, hands, and feet), except while the actual measurement is being made. Have the participant lie supine, with arms and legs (to mid-calf) bared, on a comfortable horizontal examination table.
- 1.3 Do not place blood pressure cuffs over any open lesion that could be a potential source of contamination.
- 1.4 Have the participant rest quietly for at least 5 minutes before beginning the measurement procedure. *Record the date of the examination on the Ankle-Arm Blood Pressure Form.* Before you begin the procedure, instruct the participant to remain relaxed and to refrain from helping you (e.g., lifting the arm to facilitate placement of the cuff). Once you begin the procedure, explain the steps to the participant as you proceed.
- 1.5 Place an appropriate blood pressure cuff around the arm, based on arm circumference at midpoint:
 - Adult (12 cm width) for arm circumference of >32 cm
 - Large adult (17 cm width) for arm circumference of 32–42 cm
 - Thigh (20 cm width) for are circumference of ≥ 43 cm

For the ankle, use the adult (12 cm) cuff size. Place the cuff so that the lower portion rests 3 cm above the medial malleolus (ankle bone).

2. Arterial Blood Pressure Measurement

2.1 *These first two steps are optional:* Locate the brachial artery on both arms by palpation in the antecubital fossa. Similarly, locate the dorsalis pedis (dorsum of the foot) and posterior tibial (medial ankle) arteries on both legs. Mark the location of each artery with a black marker. Sometimes the arterial location in the feet will not be palpable but can be determined with the Doppler.

2.2 Using the procedure below, measure systolic arterial pressures in the following order:

- right brachial artery
- right dorsalis pedis
- right posterior tibial
- left dorsalis pedis
- left posterior tibial
- left brachial

2.21 Place a *liberal* amount of ultrasound conducting gel over pulse location.

2.22 Place the Doppler probe over the artery and then turn on the Doppler. Angle the probe in line with the artery and move it from side to side until the strongest pulse is heard. Don't press too hard on the artery with the probe. Rest your hand comfortably so that the probe is secured in place once a strong pulse is heard.

- In a small percentage (< 10%) of participants, you will not be able to find the dorsalis pedis pulse. If you are having trouble, be patient and continue to search for at least *three minutes*. If you are still unable to locate a pulse here, *enter "999" in Field 1 on the Ankle-Arm Blood Pressure Form.*

2.23 Inflate the cuff slowly until the pulse is no longer audible. Inflate to 20 mm Hg above the level at which pulse sound disappeared. (If the pulse cannot be obliterated, you may raise pressure to a maximum 300 MMHg. If not obliterated at that point, record "unable to occlude.") Deflate the cuff slowly allowing the pressure to drop at a rate of 2 mm Hg per second. Record the pressure at which the first sustained (more than one beat) pulse reappears. This is the systolic pressure at this location. Deflate the cuff completely. *Record the measurement in Field 1 on the Ankle-Arm Blood Pressure Form.* Wait for 20 seconds and then repeat the process to obtain a pressure measurement at each of the remaining sites.

- 2.24 If the signal remains faint as more pressure is released or if the probe moves off the artery, deflate the cuff completely, wait for 20 seconds, and then repeat the measurement.
- 2.3 *Record the outcome (completed/not complete) in Item 2.* If not completed, continue to Item 3 and record the reason(s) that the procedure was not completed.